REMARKS

In view of the following discussion, the Applicant submits that none of the claims now pending in the application is made obvious under the provisions of 35 U.S.C. §103. Thus, the Applicant believes that all of these claims are now in allowable form.

I. REJECTION OF CLAIMS 1-21 UNDER 35 U.S.C. § 103

1. Claims 1-6, 10-12 and 14

Claims 1-6, 10-12 and 14 stand rejected as being made obvious by the Kado et al. patent (United States Patent No. 6,101,164, issued August 8, 2000, hereinafter "Kado"). Although the Applicant disagrees with the grounds of the rejection, the Applicant has nevertheless amended independent claim 1, from which claims 2-6, 10-12 and 14 depend, in order to more clearly recite aspects of the present invention.

Kado teaches a conductive probe contact for use in high-density recording. The probe is positioned proximate to a recording surface of a recording medium. Information is recorded on the recording medium by heating the recording medium in the area of the probe such that a physical state of the recording medium is changed in the area of the probe. In one embodiment (referred to by the Examiner as Kado Embodiment One or KE1), the tip of the probe is comprised of a conductive magnetic material. In another embodiment (referred to by the Examiner as Kado Embodiment Two or KE2), the probe is heated by a laser beam.

The Examiner's attention is directed to the fact that KE1 and KE2, singly or in any permissible combination, fail to teach, show or suggest heating a probe that is comprised of a material having temperature-dependent magnetic properties that allow a magnetic moment of the probe to be modulated in a range of temperatures above a Curie temperature of the material, as positively claimed by the Applicant. Specifically, Applicant's independent claim 1, as amended, recites:

> 1. A method for performing magnetic force microscopy comprising:
> providing a probe comprising a material having temperature-dependent magnetic properties that allow a magnetic moment of the probe

to be modulated in a range of temperatures above a Curie temperature of the material, the probe having a tip adapted for observing a surface of a sample; and

heating the probe. (Emphasis added)

The Applicant's invention is directed to the field of magnetic force microscopy (MFM). Most common methods of performing MFM produce results (*i.e.*, images of samples) that are difficult to interpret due to the presence of both magnetic and non-magnetic forces. Conventional attempts to separate the magnetic and non-magnetic forces often rely on repeat scans of the samples, which is slow and can also degrade the magnetic information.

The Applicant's invention is directed to a method and apparatus for tunable magnetic force interaction in an MFM microscope. In one particular embodiment, an MFM microscope includes a probe that is comprised of a material having temperature-dependent magnetic properties. The probe is heated with a time-varying heat source such that the magnetic moment of the probe tip (and correspondingly the magnetic field interaction between the probe tip and the sample) is oscillated, thereby substantially separating the magnetic force components of a measurement from the non-magnetic force components at any time and position over the sample.

By contrast, Kado only teaches changing the properties of the "sample" (in Kado's case, a recording medium) by heating. That is, the recording medium is, in some embodiments, coated with a magnetic material (Tb, Fe or Co) whose magnetization direction is manipulated by heating. This is not the same as changing the properties of the probe by heating.

The Applicant's invention varies the magnetic properties of the probe tip by heating. Because the probe tip is coated with a material that has temperature-dependent magnetic properties, the magnetic moment of the probe tip can be modulated by applying a time-varying heat source. The modulation of the probe's magnetic moment (and consequently of the magnetic field between the probe and the sample) facilitates true magnetic measurement of the sample (*e.g.*, substantially free of

non-magnetic forces). Neither KE1 nor KE2, nor any other portion of Kado, teaches or suggests modulating the magnetic properties of the probe by coating it with a material having temperature-dependent magnetic properties and then heating it.

The Applicant respectfully submits that the portions of Kado that the Examiner cites to support the rejection at most teach that the probe has a large magnetic permeability. Specifically, Kado teaches that the probe material has "a large magnetic permeability" so that "the line of magnetic force can be focused at the tip of the conductive probe even when a small external magnetic field is used" (*See*, Kado at column 22, lines 49-55). Thus, the desired property of the probe material, as taught by Kado, is a large magnetic permeability. Cobalt (Co), nickel (Ni) and iron (Fe) are cited as exemplary materials that exhibit this property. Co, Ni and Fe, by coincidence and as noted by the Examiner, all happen to also be ferromagnetic materials. The Examiner seems to interpret this coincidence to imply that: (1) because Co, Ni and Fe all happen to be ferromagnetic materials, Kado teaches that the probe material is ferromagnetic; and, by further extrapolation, (2) because ferromagnetic materials may be considered to have temperature-dependent magnetic properties, Kado teaches a probe having temperature dependent magnetic properties. The Applicant respectfully disagrees.

Nowhere does Kado teach or even suggest that the probe material is ferromagnetic – in fact, the term "ferromagnetic" does not appear anywhere in Kado's specification. Accordingly, the Applicant respectfully submits that the Examiner is reading teachings into Kado that simply are not there. A material that exhibits a high magnetic permeability does not necessarily have to be ferromagnetic.

Moreover, even if the teachings of Kado could be interpreted as teaching a magnetic force microscopy probe formed of a ferromagnetic material (*e.g.*, a material having temperature dependent magnetic properties), Kado still does not teach that the material properties allow the magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the material, as recited in the Applicant's amended independent claim 1. As described in the Applicant's specification (*See*, *e.g.*, paragraph [0021]), forming the probe from a material having a relatively low

Curie temperature allows for a greater range of temperatures that may be applied to the probe, and, consequently, a greater range of achievable magnetic moments over which the probe may be modulated (as the magnetic moment will be quenched at or below the Curie temperature). This stands in contrast to the teachings of Kado, as when ferromagnetic materials are heated to temperatures above their Curie point, they experience a sharp drop in magnetic permeability due to thermal disordering. Thus, a ferromagnetic material heated above its Curie point would not be suitable for use in the probe taught by Kado, as it would not exhibit the desired high magnetic permeability. Accordingly, the Applicant submits that Kado actually teaches away from the claimed invention.

Therefore, Applicant respectfully submits that independent claim 1, as amended, is clearly patentable and not made obvious by Kado. Furthermore, dependent claims 2-6, 10-12 and 14 depend, either directly or indirectly, from claim 1 and recite additional limitations therefor. As such, and for at least the same reasons set forth above, the Applicant submits that claims 2-6, 10-12 and 14 are also patentable and not made obvious by Kado. Accordingly, the Applicant respectfully requests that the rejection of claims 1-6, 10-12 and 14 under 35 U.S.C. § 103 be withdrawn.

2. Claims 7-8

Claims 7-8 stand rejected as being made obvious by Kado in view of the Kitazawa patent application (United States Patent Application Publication No. 2002/0178799, published December 5, 2002, hereinafter "Kitazawa"). The Applicant respectfully traverses the rejection.

Kado has been discussed above. Kitazawa teaches a scanning probe microscope (SPM) cantilever. Specifically, Kitazawa teaches an SPM cantilever including a probe formed of single-crystal silicon. In some embodiments, a ferromagnetic material such as Ni (nickel), nickel-iron, ferrite or Permalloy is formed on the side face of the probe portion and a terminal end probe portion.

As discussed above, Kado (and specifically KE1 and KE2 of Kado) fails to teach,

show or suggest heating a probe that is comprised of a material having temperature-dependent magnetic properties that allow the magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the material, as positively claimed by the Applicant in amended independent claim 1, recited above. Kitazawa fails to bridge this gap in the teachings of Kado.

Therefore, Applicant respectfully submits that independent claim 1 is clearly patentable and not made obvious by Kado in view of Kitazawa. Furthermore, dependent claims 7-8 depend from claim 1 and recite additional limitations therefor. As such, and for at least the sames reason set forth above, the Applicant submits that claims 7-8 are also patentable and not made obvious by Kado in view of Kitazawa. Accordingly, the Applicant respectfully requests that the rejection of claims 7-8 under 35 U.S.C. § 103 be withdrawn.

3. Claim 9

Claim 9 stands rejected as being made obvious by Kado in view of the Farina et al. patent (United States Patent No. 5,856,880, issued January 5, 1999, hereinafter "Farina"). The Applicant respectfully traverses the rejection.

Kado has been discussed above. Farina teaches a method for laser-assisted thermo-electric poling of ferroelectric material. According to Farina, a ferroelectric material is selectively poled by first heating a surface of the material at a temperature near the material's Curie temperature, but below the material's melting temperature. The heating is done using a light beam (*e.g.*, a laser) and is performed while applying an electric field to the heated region having a component along the desired polarization direction. The material is then allowed to cool with the electric field in place.

As discussed above, Kado (and specifically KE1 and KE2 of Kado) fails to teach, show or suggest heating a probe that is comprised of a material having temperature-dependent magnetic properties that allow the magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the material, as positively claimed by the Applicant in independent claim 1, recited above. Farina fails to

bridge this gap in the teachings of Kado.

Therefore, Applicant respectfully submits that independent claim 1 is clearly patentable and not made obvious by Kado in view of Farina. Furthermore, dependent claim 9 depends from claim 1 and recites additional limitations therefor. As such, and for at least the exact same reason set forth above, the Applicant submits that claim 9 is also patentable and not made obvious by Kado in view of Farina. Accordingly, the Applicant respectfully requests that the rejection of claim 9 under 35 U.S.C. § 103 be withdrawn.

4. Claim 13

Claim 13 stands rejected as being made obvious by Kado in view of the Nakayama et al. patent application (United States Patent Application Publication No. 2002/0110177, published August 15, 2002, hereinafter "Nakayama"). The Applicant respectfully traverses the rejection.

Kado has been discussed above. Nakayama teaches a heat emitting probe and heat emitting probe apparatus. In particular, Nakayama teaches a heat emitting probe that includes a conductive nanotube probe needle with its base end fastened to a holder and its tip end protruded, a heat emitting body formed on the probe needle, a conductive nanotube lead wire fastened to the heat emitting body, and an electric current supply that causes an electric current to pass through the conductive nanotube lead wire and both ends of the probe needle. The tip end of the probe needle is thus heated by an electric current flowing through the heat emitting body.

As discussed above, Kado (and specifically KE1 and KE2 of Kado) fails to teach, show or suggest heating a probe that is comprised of a material having temperature-dependent magnetic properties that allow the magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the material, as positively claimed by the Applicant in independent claim 1, recited above. Nakayama fails to bridge this gap in the teachings of Kado.

Therefore, Applicant respectfully submits that independent claim 1 is clearly

patentable and not made obvious by Kado in view of Nakayama. Furthermore, dependent claim 13 depends from claim 1 and recites additional limitations therefor. As such, and for at least the exact same reason set forth above, the Applicant submits that claim 9 is also patentable and not made obvious by Kado in view of Nakayama. Accordingly, the Applicant respectfully requests that the rejection of claim 13 under 35 U.S.C. § 103 be withdrawn.

5. Claims 18-19

Claims 18-19 stand rejected as being made obvious by the Kitamura patent (United States Patent No. 6,504,365, issues January 7, 2003, hereinafter "Kitamura") in view of Kado. Although the Applicant disagrees with the grounds of the rejection, the Applicant has nevertheless amended independent claim 18, from which claim 19 depends, in order to more clearly recite aspects of the present invention.

Kado has been discussed above. Kitamura teaches a magnetic force microscope (MFM). The MFM includes a magnetized cantilever having a probe attached to its free end and an oscillation means for exciting the cantilever into oscillation. Various control means operate to monitor and control the position and oscillation of the cantilever relative to the sample at given times

The Examiner's attention is directed to the fact that Kitamura, like Kado, fails to teach, show or suggest heating a probe tip comprising a low Curie temperature material that allows the magnetic moment of the probe tip to be modulated in a range of temperatures above the Curie temperature as positively claimed by the Applicant. Specifically, Applicant's independent claim 18, as amended, recites:

> 18. A magnetic force microscope comprising:
> a cantilever adapted for oscillating, wherein the cantilever has a first end and a second end;
> a probe coupled to the second end of the cantilever, wherein the probe has a tip comprising a low Curie temperature material that allows a magnetic moment of the probe tip to be modulated in a range of temperatures above the Curie temperature;
> a laser adapted for illuminating the second end of the cantilever;

an optical detector adapted for detecting light reflected by the cantilever; and

a heat source adapted for heating the probe. (Emphasis added)

As discussed above, the Applicant's invention varies the magnetic properties of the probe tip by heating. Because the probe tip is comprised of a material that has a low Curie temperature (*e.g.*, a temperature at which a material's magnetic moment is "quenched"), modulation of the probe tip's magnetic moment is facilitated within certain obtainable ranges of temperature. The modulation of the probe's magnetic properties (and consequently of the magnetic field between the probe and the sample) facilitates true magnetic measurement of the sample (*e.g.*, substantially free of non-magnetic forces). Neither Kitamura nor Kado teaches or suggests varying the magnetic properties of the probe by forming the tip of a low Curie temperature material that allows the magnetic moment of the probe tip to be modulated in a range of temperatures above the Curie temperature and then heating it.

Therefore, Applicant respectfully submits that independent claim 18 is clearly patentable and not made obvious by Kitamura in view of Kado. Furthermore, dependent claim 19 depends from claim 18 and recites additional limitations therefor. As such, and for at least the exact same reason set forth above, the Applicant submits that claim 19 is also patentable and not made obvious by Kitamura in view of Kado. Accordingly, the Applicant respectfully requests that the rejection of claims 18-19 under 35 U.S.C. § 103 be withdrawn.

6. Claims 20- 21

Claims 20-21 stand rejected as being made obvious by Kitazawa in view of Kado. Although the Applicant disagrees with the grounds of the rejection, the Applicant has nevertheless amended independent claim 20, from which claim 21 depends, in order to more clearly recite aspects of the present invention.

Kitazawa and Kado have been discussed above. The Examiner's attention is directed to the fact that Kitazawa and Kado, singly and in any permissible combination,

fail to teach, show or suggest heating a probe tip comprising a ferrimagnetic material that allows a magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the ferrimagnetic material, as positively claimed by the Applicant. Specifically, Applicant's independent claim 20, as amended, recites:

> 20. A magnetic force microscope comprising:
> a cantilever adapted for oscillating, the cantilever having a first end and a second end;
> a probe coupled to the second end of the cantilever, the probe having a tapered tip comprising a ferrimagnetic material that allows a magnetic moment of the probe to be modulated in a range of temperatures above a Curie temperature of the ferrimagnetic material;
> a motion detector adapted for detecting deflection of the cantilever; and
> a heat source adapted for heating the probe.
> (Emphasis added)

As discussed above, the Applicant's invention varies the magnetic properties of the probe tip by heating. Because the probe tip is comprised of a material that is ferrimagnetic, modulation of the probe tip's magnetic moment is facilitated. The modulation of the probe's magnetic properties (and consequently of the magnetic field between the probe and the sample) facilitates true magnetic measurement of the sample (*e.g.*, substantially free of non-magnetic forces). Neither Kitazawa nor Kado teaches or suggests varying the magnetic properties of the probe by forming the tip of a ferrimagnetic material that allows a magnetic moment of the probe to be modulated in a range of temperatures above the Curie temperature of the ferrimagnetic material and then heating it.

Therefore, Applicant respectfully submits that independent claim 20 is clearly patentable and not made obvious by Kitazawa in view of Kado. Furthermore, dependent claim 21 depends from claim 20 and recites additional limitations therefor. As such, and for at least the exact same reason set forth above, the Applicant submits that claim 21 is also patentable and not made obvious by Kitazawa in view of Kado. Accordingly, the Applicant respectfully requests that the rejection of claims 20-21 under

35 U.S.C. § 103 be withdrawn.

II. ALLOWABLE SUBJECT MATTER

The Applicant thanks the Examiner for his comments regarding the allowability of claims 15-17, if rewritten into independent form including all of the limitations of the base claim and any intervening claims. However, the Applicant submits that, in light of the amendment and arguments present above, independent claim 1, from which claims 15-17 depend, is in allowable form. Accordingly, the Applicant respectfully submits that claims 15-17 are allowable in their present form.

III. CONCLUSION

Thus, the Applicant submits that all of the presented claims fully satisfy the requirements of 35 U.S.C. §103. Consequently, the Applicant believes that all of the presented claims are presently in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issue are earnestly solicited.

If, however, the Examiner believes that there are any unresolved issues requiring the issuance of a final action in any of the claims now pending in the application, it is requested that the Examiner telephone Mr. Kin-Wah Tong, Esq. at (732) 530-9404 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

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